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DESIGNATED/ELECTED OFFICE (DO/EO/US)
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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/889064

INTERNATIONAL APPLICATION NO.

PCT/DE 00/04009

INTERNATIONAL FILING DATE

NOVEMBER 10, 2000

PRIORITY DATE CLAIMED

NOVEMBER 15, 1999

TITLE OF INVENTION

STARTER SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

APPLICANT(S) FOR DO/EO/US

Karsten MUELLER, Manfred KLAUE, Orf SCHNEIDER, Stefan OSSENKOPP, Siegbert WESSELS, Harald BUEHREN

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☒ Certificate of Mailing by Express Mail
19. ☐ Other items or information:

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UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Group: Attorney Docket # 1666

Applicant(s) : MUELLER, K., ET AL

Serial No. :

Filed : Simultaneously

For : STARTER SYSTEM FOR AN INTERNAL
COMBUSTION ENGINE

SIMULTANEOUS AMENDMENT

July 11, 2001

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

S I R S:

Simultaneously with filing of the above identified application
please amend the same as follows:

In the Claims:

Cancel all claims without prejudice.

Substitute the claims attached hereto.

REMARKS:

This Amendment is submitted simultaneously with filing of the above identified
application.

With the present Amendment applicant has amended the claims so as to eliminate
their multiple dependency.

Consideration and allowance of the present application is most respectfully requested.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Michael J. Striker', written over a horizontal line.

Michael J. Striker
Attorney for Applicant(s)
Reg. No. 27233

Claims

1. A starter system for an internal combustion engine, in particular in motor vehicles, having a starter motor, a reduction gear, and a pinion-engaging assembly, characterized in that the primary components of the starter system (10) are embodied as individual modules and can be expanded in variable ways to make starter systems (10) with different parameters.

2. The starter system of claim 1, characterized in that the starter system (10) includes a drive module (18), a gear module (20), and an electronic module (36).

3. The starter system of [one of the foregoing claims] claim 1, characterized in that the drive module (18) can be combined with different gear modules (20).

4. The starter system of [one of the foregoing claims] claim 1, characterized in that the gear module (20) can be combined with different drive modules (18).

5. The starter system of [one of the foregoing claims] claim 1, characterized in that the gear module (20) includes a planetary gear.

6. The starter system of [one of the foregoing claims] claim 1, characterized in that a sun wheel of the planetary gear is a slip-on pinion (24) of a drive shaft (22) of the drive module (18).

7. The starter system of [one of the foregoing claims] claim 1, characterized in that the gear module (20) includes an

integrated free-wheel mechanism.

8. The starter system of [one of the foregoing claims]
claim 1, characterized in that the electronic module (36) is
5 disposed between the drive module (18) and the gear module (20).

Claims

1. A starter system for an internal combustion engine, in particular in motor vehicles, having a starter motor, a reduction gear, and a pinion-engaging assembly, characterized in that the primary components of the starter system (10) are embodied as individual modules and can be expanded in variable ways to make starter systems (10) with different parameters.

2. The starter system of claim 1, characterized in that the starter system (10) includes a drive module (18), a gear module (20), and an electronic module (36).

3. The starter system of claim 1, characterized in that the drive module (18) can be combined with different gear modules (20).

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6. The starter system of claim 1, characterized in that a sun wheel of the planetary gear is a slip-on pinion (24) of a drive shaft (22) of the drive module (18).

7. The starter system of claim 1, characterized in that the gear module (20) includes an integrated free-wheel mechanism.

8. The starter system of claim 1, characterized in that

the electronic module (36) is disposed between the drive module (18) and the gear module (20).

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STARTER SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

The invention relates to a starter system for an internal combustion engine, in particular in motor vehicles, having the characteristics recited in the preamble to claim

5 1.

Prior Art

It is known that internal combustion engines have to be cranked until they reach the point where they run on their own. To that end, so-called starter systems are used in
10 motor vehicles. These starter systems include a starter motor, supplied by a motor vehicle battery, a reduction gear, and a pinion-engaging assembly. For starting the engine, the starter motor is connected to the motor vehicle battery via a starter switch (ignition switch). Once the starter motor is
15 put in operation, a pinion is made to engage a ring gear disposed on a crankshaft of the engine, so that the engine can be cranked. Since the starter motors have a substantially higher rpm than what is required to crank the engine, these different rotary speeds are adapted via a
20 reduction gear. The reduction gear is typically embodied as a planetary gear, with the sun wheel drivable by the starter motor and the crankshaft operatively connected to the planet wheels.

A crankshaft torque required to crank the engine and a
25 minimum crankshaft rpm depend on engine parameters, such as stroke volume, number of cylinders, compression, friction losses, temperature, and additional loads. Thus a starter system has to be adapted to the parameters of the engine. In

particular, there is a need for starter systems with different starting power levels and/or different starting rotary speeds.

5 In the known starter systems, it is disadvantageous that for the sake of high utilization of installation space, they are embodied in a so-called inter-nested way, and that to adapt the starter power and/or the starting rotary speed of the starter, many different-sized starter systems are needed. Adapting to altered parameters of an engine can be
10 done only by redimensioning or reconstructing the entire starter system.

Advantages of the Invention

The starter system of the invention having the characteristics recited in claim 1 offers the advantage over
15 the prior art that adaptation to engines of different parameters can be done in a simple way. Because the primary components of the starter system are embodied as individual modules and can be expanded variably into starter systems with different parameters, it is simple, beginning with the
20 individual modules, to achieve different starter systems without having to reconstruct the entire starter system.

In a preferred feature of the invention, it is provided that the starter system includes a drive module, a gear module and an electronic module. This makes it possible for
25 the primary components of the starter system to be optimized individually to desired starting parameters, so that the desired starter system with the requisite parameters can be assembled from the existing variously-sized individual modules. It is also preferable for a drive module to be
30 combinable with different gear modules, so that adapting the

starter system to a desired crankshaft rpm can be done solely via the gear modules. Thus the same type of drive modules can be combined with the appropriate gear modules. On the other hand, it is equally possible for different crankshaft
5 torques to be attained via drive modules with different power level parameters but the same gear modules.

Overall, it becomes clear that by the modular design of the starter system provided for by the invention, identical component groups can be used for different starter system
10 power level classes. By taking standard sizes into account in the individual component groups, these groups can be accordingly assembled in final form economically, thus reducing both the effort and cost of production. In particular, this also makes for high flexibility in final
15 assembly of the starter system, especially when making a rapid adaptation to altered application requirements of different internal combustion engines.

Further advantageous features of the invention will become apparent from the other characteristics recited in the
20 dependent claims.

Drawings

The invention is described in further detail below in terms of exemplary embodiments in conjunction with the associated drawings. Shown are:

25 Fig. 1, a sectional view through a starter system of the invention in a first exemplary embodiment;

Fig. 2, primary component groups of the starter system of Fig. 1;

Fig. 3, a sectional view through a starter system in a second exemplary embodiment; and

Fig. 4, a block diagram illustrating the production of the starter systems of the invention.

5 Description of the Exemplary Embodiments

Fig. 1 shows a starter system, identified overall by reference numeral 10, for an internal combustion engine, not shown. Inside a housing 12, the starter system 10 includes a starter motor 14 and a reduction gear 16 embodied as a planetary gear. The structure and function of such starter systems 10 are known, so that these will not be addressed further in the present description.

In Fig. 2, sectional views of the two primary groups of the starter system are shown, in the state before final assembly. The drive motor 14 forms a drive module 18, and the reduction gear 16 forms a gear module 20. The starter motor 14 is a direct current motor, whose structure and function are likewise well known. An armature shaft 22 of the starter motor 14 has a pinion 24, which is disposed on the armature shaft 22 in a manner fixed against relative rotation. The armature shaft 22 is extended past the housing 26 of the starter motor 14 and can be introduced into a guide 28 of the reduction gear 16. When the drive module 18 is mounted to the gear module 20, the armature shaft 22 engages the guide 28, so that the slip-on pinion 24 meshes planet wheels 30 of the reduction gear 16. The slip-on pinion 24 thus forms the sun wheel of the reduction gear (planetary gear) 16. An output shaft 32 of the gear module 20 has a pinion 34, which in a manner known per se can be made to engage a ring gear disposed on a crankshaft of the engine.

Depending on a demand for rotary speed and/or torque for starting (cranking) the engine, the starter system 10 can be dimensioned accordingly by a suitable choice of the drive module 18 and/or gear module 20. The torque can be achieved
5 by choosing a power level of the starter motor, which can range between 0.7 kW and 2.3 kW, for instance. The adaptation to a required rotary speed can be done by means of a gear ratio of the reduction gear 20, and by the choice of a suitable slip-on pinion 24, the gear ratio can be varied,
10 with otherwise the same drive module 18 and gear module 20. It becomes clear that at little effort or expense, starter systems 10 for different requirements can thus be furnished in a simple way, for instance with regard to a crankshaft torque and/or a crankshaft rpm. The various basic components
15 of the starter system 10 can be made economically by mass production, since a specific adaptation is possible either by selecting the drive module 18 and/or selecting the slip-on pinion 24 and/or the gear module 20.

A free-wheel mechanism of the starter system 10 is
20 integrated with the reduction gear 20. This free-wheel mechanism disconnects the starter motor 14 from the crankshaft of the internal combustion engine once this engine is at a minimum rpm. This averts the possibility of damage to the drive motor 14 when the armature rpm is exceeded by
25 the crankshaft rpm.

Fig. 3 shows a modified starter system 10, in which in addition to the drive module 18 and the gear module 20, an electronic module 36 is integrated. The electronic module 36 takes on control functions for the starter system 10, such as
30 a start/stop function, current clocking and/or an immobilizer function. Such functions are likewise known. Of interest to the present invention is the fact that the electronic module

36 is integrated as a compact module into the housing 12 of the starter system 10. The electronic module 36 can for instance be flanged to the drive module 18. To span the axial length of the electronic module 36, the armature shaft 22 is embodied as correspondingly longer, so that it can engage the guide portion 28 of the gear module 20. It is quite clear from Fig. 3 that by replacing the electronic module 36, different functions of the starter system 10 can easily be incorporated into the starter system 10 as desired by the user. The other components, the drive module 18 and the gear module 20, remain untouched by such an adaptation.

Overall, it can be stated that each of the individual modules, that is, the drive module 18, the electronic module 36 and/or the gear module 20, can be optimized on its own. These modules are standardized in the sense that in the final assembly of starter systems 10, various drive modules 18, electronic modules 36 and gear modules 20 that are in stock can be combined selectively with one another. The sole decisive factor is what the user of the starter system 10 requires.

Fig. 4, in a block circuit diagram, illustrates the final assembly of starter systems 10 from different modules. Block 40 indicates the production of the drive modules 18, block 42 the production of the gear modules 20, and block 44 the production of the electronic modules 36. For producing the drive modules 18, it is shown in suggested form inside the complex 40 for instance that the armature shaft is furnished in a step 46, the armature assembly is done in a step 48, the pole housing assembly is done in a step 50, and finally the assembly of the drive module 18 is done in a step 52.

Depending on the application demand made of the starter system 10, the appropriate drive module 18, the appropriate gear module 20 and the appropriate electronic module 36 are then completed in a final step 54 to make the desired starter system 10. By means of the modular construction explained, in which the individual modules are compatible with one another even given different power level parameters and speed-increase parameters, the production of starter systems 10 can be simplified considerably and thus made more economical.

Claims

1. A starter system for an internal combustion engine, in particular in motor vehicles, having a starter motor, a reduction gear, and a pinion-engaging assembly, characterized in that the primary components of the starter system (10) are embodied as individual modules and can be expanded in
5 variable ways to make starter systems (10) with different parameters.

2. The starter system of claim 1, characterized in that the starter system (10) includes a drive module (18), a gear module (20), and an electronic module (36).

3. The starter system of one of the foregoing claims, characterized in that the drive module (18) can be combined with different gear modules (20).

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integrated free-wheel mechanism.

8. The starter system of one of the foregoing claims, characterized in that the electronic module (36) is disposed between the drive module (18) and the gear module (20).

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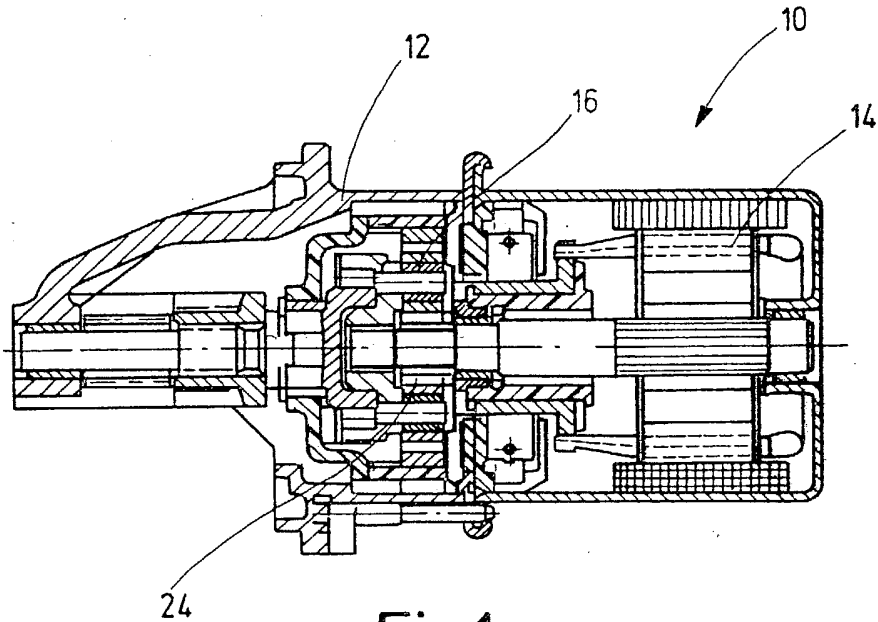


Fig.1

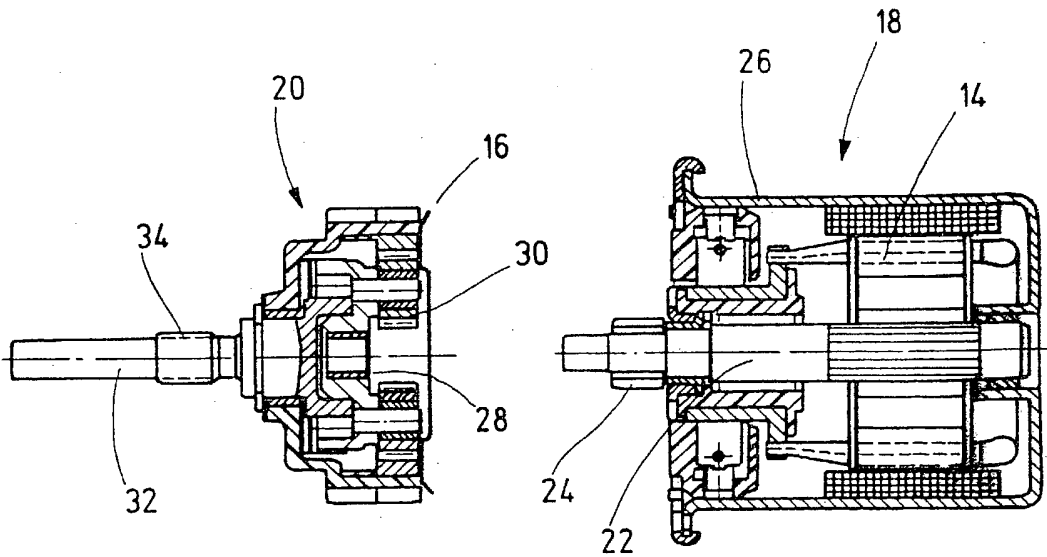


Fig.2

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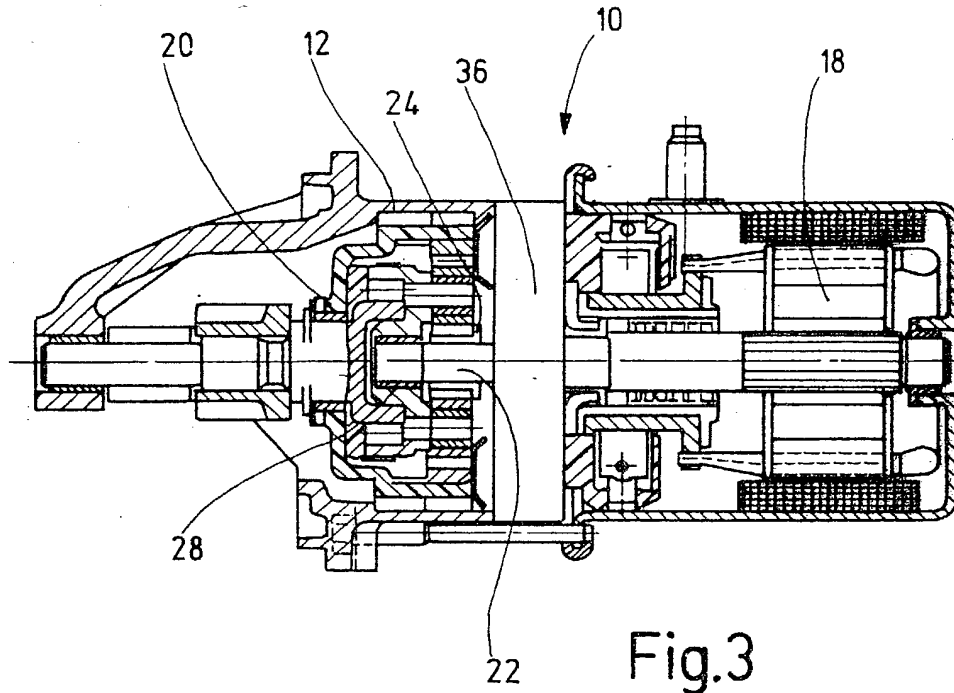


Fig.3

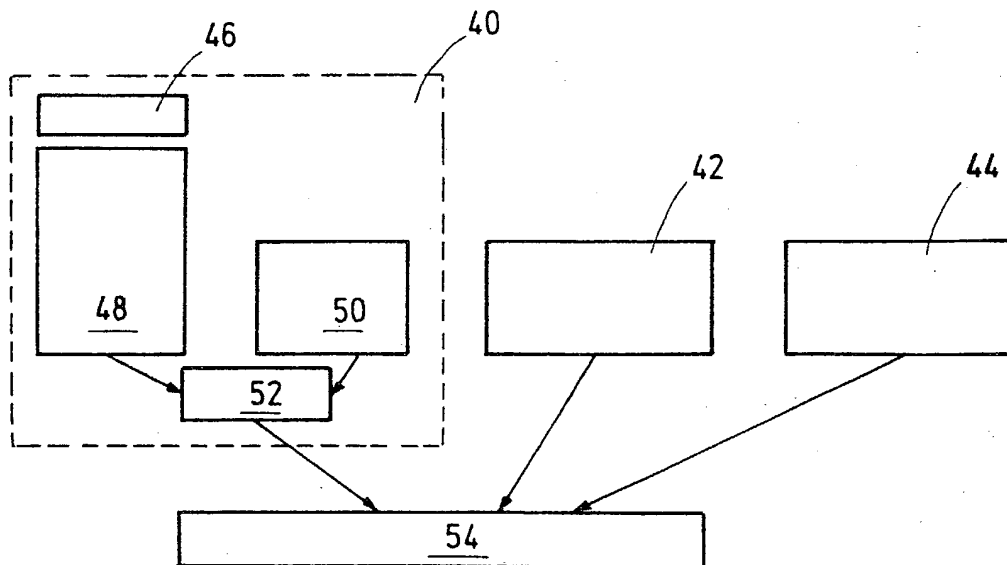


Fig.4

DECLARATION AND POWER OF ATTORNEY FOR NATIONAL STAGE OF PCT PATENT APPLICATION

As a below-named inventor, I hereby declare that:

Karsten MUELLER
Manfred KLAUE
Orf SCHNEIDER

Stefan OSSENKOPF
Siegbert WESSELS
Harald BUEHREN

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **STARTER SYSTEM FOR AN INTERNAL COMBUSTION ENGINE** the specification of which was filed as PCT International Application number PCT/DE 00/04009 on November 10, 2000.

I hereby state that I believe the named inventor or inventors in this Declaration to be the original and first inventor or inventors of the subject matter which is claimed and for which a patent is sought.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365 (b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior foreign application(s):

Priority claimed:

199 55 061.1	GERMANY	NOVEMBER 15, 1999	X	
(Number)	(Country)	(Date filed)	Yes	No
_____	_____	_____	Yes	No
(Number)	(Country)	(Date filed)	Yes	No

As a named inventor, I hereby appoint the following attorney to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Michael J. Striker, Reg. No. 27233

Direct all telephone calls to Striker, Striker & Stenby at telephone no.: (631) 549 4700 and address and all correspondence to:

STRIKER, STRIKER & STENBY
103 East Neck Road
Huntington, New York 11743
U.S.A.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with

the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statement may jeopardize the validity of the application or any patent issued thereon.

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	Full Name of Sixth Inventor: <u>Harald BUEHREN</u>	Citizenship: GERMAN		
	Signature:	Date:	Residence and Full Postal Address:	
	Full Name of Seventh Inventor:	Citizenship:		
	Signature:	Date:	Residence and Full Postal Address:	
	Full Name of Eighth Inventor:	Citizenship:		